

## **Restoration Plan, Keeney Property**

### **Summary:**

The following plan describes the restoration of a 56-acre agricultural site adjacent to Butte Creek.

Approximately 6 acres of wetlands will be created by the excavation and removal of 6,000 cubic yards of material. The wetland will be planted with typical seasonal marsh species.

Additionally, approximately 9 acres of wetland riparian forest will be planted in a band running parallel to Butte Creek. The band will be set back 50 feet from the bank of Butte Creek, 250 feet from the Midway Bridge, and 150 feet from the north levee. The riparian zone will be mowed for weed control during the plant establishment phase of the restoration process, but will be allowed to develop riparian character after the canopy closes and weed pressure decreases. The remaining 47 acres will be revegetated with native grasses and will either be mowed or grazed annually.

The issues identified in designing this plan were:

- potential for impacts to flooding on the creek from 1) increased coefficient of roughness due to higher plant density (riparian community Vs typical orchard planting) and 2) increased debris clogging the channel;
- potential weed propagule source for adjacent and downstream neighbors.

The restoration plan was designed to ensure that neither of these negative impacts would occur. Specifically, the coefficient of roughness of the riparian strip will be higher than that of the previously existing orchard, but the coefficient of roughness of much of the site will be substantially reduced from that of the orchard.

The site will be managed in perpetuity. On a yearly basis, any downed trees or brush will either be chopped (material less than 1" diameter will be chopped and used as mulch on site) or large diameter woody debris will be cut into 3-foot sections. The grassland will be either mowed or grazed to a height of less than 24".

The proposed draft restoration plan was submitted to the Butte County Agriculture Commissioner for comment regarding potential agricultural weed

generation from the site. The commissioner found the proposed species do not pose a threat to agricultural operations. To ensure that weeds do not cause problems to adjacent property owners, a 980-foot buffer has been established between the riparian plantings and the orchard to the east.

## 1. Introduction

### 1.1 Site History and Restoration Design:

The Center for Natural Lands Management (CNLM) recently purchased from Keeney & Son Farms Inc., a 56- acre parcel along Butte Creek in Butte County California. The property is located on the west side of Butte Creek and has approximately 4,000 feet of creek frontage (See Figure 1, Vicinity Map). Until recently, the site was occupied by a young almond orchard; it is currently fallow.

This site is located within the flood plain of Butte Creek and thus restoring native vegetation has the potential to exacerbate flooding in the creek by either contributing woody debris during floods or increasing the coefficient of roughness for the site. The restoration plan has been carefully designed to be ensure that flooding will not be exacerbated by the restoration of this site.

During agricultural development of the site a hanging channel of the creek was filled when the land was leveled. This channel will be excavated and approximately 6.0 acres of wetland habitat will be created. A 2,960' by 130' belt of new riparian habitat running parallel to Butte Creek will be created.

The remainder of the site will be restored to a native-grassland and will be mowed or grazed annually to less than 24" to reduce potential flooding (See Figure 2 and 3 Restoration Plan). The functions and values of restored habitat will closely resemble those of natural wetlands and riparian zones in the area (See Figures, 4, 5, 6 and 7).

Partial funding for the purchase of the land and the restoration effort has come from the Butte County Fish and Game Commission. The County, with endorsement from the State of California, Department of Fish and Game plans to use up to 15 acres of the restored site as a mitigation bank for projects with impacts to riparian zones and other seasonal wetlands in Butte County. The remainder of the site will serve as a federal conservation project.

### 1.2 Goals and Objectives:

The long-term goal of the revegetation program for the CNLM is to recreate an assemblage of native plant associations that mimic, as fully as possible, an early successional stage of mixed riparian forest to replace similar habitat that has been lost in the county as a result of urbanization and agricultural encroachment.

Additional goals of the revegetation program are:

- create 9.0 acres of riparian and 6.0 acres wetland habitat for mitigation bank for California Department of Fish and Game 1600 Agreements issued in Butte County,
- increase shady riverine habitat on Butte Creek, and
- long-term wildlife enhancement.

Specific objectives of the revegetation program include:

- site preparation,
- initial seeding and planting plan,
- long-term maintenance plan,
- ongoing exotic plant species control,
- periodic revegetation monitoring, and
- annual revegetation report preparation.

## 2.0 Analysis of Existing Conditions

### 2.1 Hydrology

The hydrology of Butte Creek is dynamic. Butte Creek is a fourth-order creek that empties into the Sacramento River. Watershed elevations range from 7,087 feet at the headwaters to 50 feet near the Sacramento River. The restoration site adjacent to the creek is at 190 feet. Butte Creek is influenced by both snow-melt and precipitation with rain the most significant cause of periodic flooding. Precipitation within the watershed averages 59.62 inches a year with 23.33% occurring on slopes > 15%. The average base flow of Butte Creek near the restoration site is 168 cfs at a river stage of 1.12 feet. Periodic flooding does occur and inundation at the restoration site is likely to occur whenever the creek exceeds 9,500 cfs. The creek exceeds this flow on average every 6.7 years. The peak flow record taken near the restoration site measured over 36,500 cfs with water nearly twelve feet deep on the site. Vegetation planting and restoration design take into consideration that the site is located within a 5-10 year flood plain.

## 2.2 Soils

The soils on the site are variable but well-suited to the establishment of cottonwood riparian forest with a mixed perennial grass shrub understory. The hydrology of Butte Creek has changed substantially in the past 150 years. Impacts to hydrology have included mining and the construction of dams and levees. These changes have impacted the depositional environment at the site. The soils are now forming in loamy to sandy alluvial deposits and are augmented periodically with new alluvium from stream deposition during occasional flooding events. Historically, the site occupied a basin rim position and the soils were forming in fine material.

The deposits appear to be typical of low stream terraces or flood plain deposits associated with Butte Creek and the surface configuration of the site is consistent with that of a low stream terrace. This site is located on a transition from alluvial fan to basin rim; coarser flood plain material is being overlaid on fine basin rim material (note the dark clay horizon at 34 inches).

The soils were mapped by the Natural Resources Conservation Service (NRCS) as **Govstanford Loam, 0 to 1 percent slopes, occasionally flooded.**

A typical profile consists of:

0 -3 inches	pale brown loam
3 -11 inches	pale brown loam
11 - 18 inches	light yellowish brown sandy loam
18 - 25 inches	yellowish brown silt loam
25 - 34 inches	yellowish brown silt loam with dark brown and grayish brown mottles
34 - 42 inches	buried black clay
42 - 72 inches	very dark gray and very dark grayish brown silty clay

The soils mapped at the project site are variable; the survey does not show the possible inclusions at the site. Of particular interest to revegetation design is the variation of the depth and thickness of the clay horizons. Soils were described in the vicinity of the old channel. A buried gravel lens was encountered at 60 inches. This feature has implications for the suitability of the site for wetland creation.

Surface deposition of alluvial material is still occurring. It appears that up to 36 inches of material have been deposited in the last 150 years. Continued deposition of material may in time fill in any constructed wetlands on the site.

## 2.3 Vegetation

A thin, patchy corridor of riparian vegetation exists along the edge of the property fronting Butte Creek. Over story vegetation of the riparian corridor consists of cottonwoods (*Populus fremontii*), narrowleaf willow (*Salix exigua*), black willow (*Salix gooddingii*), northern California black walnut (*Juglans hindsii*), alder (*Alnus rhombifolia*), and valley oak (*Quercus lobata*). A few introduced trees including tree of heaven (*Ailanthus altissima*), are interspersed amongst the native vegetation. Shrub cover consists mainly of Himalayan blackberry (*Rubus discolor*) with dense patches of Johnson grass (*Sorghum halepense*). Numerous cottonwood seedlings are growing throughout the site.

The site also supports a full complement of common agricultural weeds and will require significant weed control measures prior to planting native species as part of the restoration measures.

## 2.4 Wildlife

Both resident and anadromous fish are found in Butte Creek. Resident fish include Pike Minnow, Sacramento Sucker, Small mouth bass, Largemouth bass, Rainbow trout, catfish, carp, green sunfish, and hardhead. Several anadromous fish species such as steelhead and fall and spring-run chinook salmon use the creek during their respective runs. Fall run salmon spawn near the project site whereas spring run salmon spawn in the lower canyon up to 1000' elevation. Riparian habitat provides shaded riverine areas, woody debris, and organic matter that benefit all fish species. Salmonids especially benefit from shaded riverine areas because it serves to keep water temperatures low and provide escape cover. The fall salmon run is currently under review for listing by the National Marine Fisheries Service as an endangered species and spring-run chinook salmon have been listed as threatened by the California Fish and Game Commission.

## 3.0 Rationale for Wetland Excavation and Restoration Design

### 3.1 Wetland Excavation

A historic hanging channel that was filled during farming operations will be excavated. The approximate length of the wetland will be 600' and the depth will be between 2-3 feet. Excavated material will be hauled from the floodplain of Butte Creek. The channel has been placed in an area with a clay subsoil which is relatively impermeable to water. It is anticipated that in most years the wetland will hold incident rainfall for up to 3 weeks after the rainy season ends.

After flood events fill the excavated wetland, it may hold water for as long as several months.

### 3.2 Revegetation Design

The information used to develop the planting design is based upon the site assessment: soil patterns, flooding frequency and duration, bank erosion, and sediment deposition. Table 1 summarizes major ecological processes and habitat parameters at the project site.

Table 1. Major ecological processes and habitat parameters at the project site.

Soils	Stratified, loam over buried clay, variable gravel lens at 6'
Flood frequency	Occasional (6.7 years)
Flood duration	Hours up to several days
Bank erosion	None threatening restoration site
Deposition	Siltation over entire site.
Depth to water table	Set by Butte Creek

Table 1 highlights some important factors. Flooding is occasional, but may be long in duration with significant sediment deposition when it does occur. As a result, we chose a high percentage of trees capable of sprouting new root systems when buried by sediment such as cottonwoods, willows, boxelders, and sycamores. When irrigation is completed (2 years after final planting), the tree roots are expected to have reached the water table.

Seasonal Wetland- This community will occupy the bottom and lower side slopes of the excavated wetland and will abut the Great Valley cottonwood riparian forest community. For purposes of the revegetation plan the channel was divided into three habitat types which were defined by potential water regime. The driest habitat is the rainfed uplands at the top of the channel walls. The midsection on the channel is intermediate in wetness; it is periodically saturated through capillary rise from the wetland and dries out as the water level in the depression drops. The toe slope and bottom of the wetland is the wettest habitat and it may be occasionally inundated. Plant selection will include a fast growing grass component for immediate slope stabilization and erosion and dust control and a perennial grass component for long-term stabilization. Species were chosen for each of the habitats described above. Species to be planted in this area are perennial wetland grasses such Santa Barbara sedge (*Carex barbarae*), Bolander's rush (*Juncus balticus*), and iris leafed rush (*Juncus xiphioides*).

Great Valley Cottonwood Riparian Forest - This community will occupy the band running parallel to Butte Creek. To complement the strong recruitment of native cottonwoods and willows already taking place along the creek banks and low areas on the site, young plants of these and other riparian species such as Oregon ash ( *Fraxinus latifolia*), alder (*Alnus rhombifolia*), and California blackberry (*rubus ursinus*) will be planted. It is expected that other species such as wild grape (*vitis californica*) and box elder (*Acer negundo californica*) will be recruited to the community.

### Wildlife Considerations

Butte Creek, like all creeks within the Sacramento Valley, floods regularly. There is a possibility of trapping fish on the flood plain in the created wetland following flood events. The proposed wetland is relatively small, therefore the number of fish that could be trapped is low. Native fish have evolved in these dynamic systems and have developed behavior patterns and adaptations, which allow them to survive during these periodic flood events. The potential loss of a few fish will be mitigated by the creation of shaded riverine areas and crucial wetland habitat. The wetland will be monitored for trapped juvenile fish after flood events.

## 4.0 Planting Plan

The revegetation plan makes use of habitat restoration and enhancement techniques rather than wetland creation techniques that may have a greater risk of failure.

The plant associations will be laid out by a professional revegetation specialist, using stakes or color coded flags. Within each community, seed mixes to be broadcast will be evenly distributed. Plants to be installed by other methods will be laid out in irregular and naturalistic groupings by the revegetation specialist.

### 4.1 Planting schedule

Planting will take place during the rainy season from October through May. Solid set irrigation will be used to supplement the needs of the trees during the summer months.

### 4.2 Planting layout

The mixed riparian forest species will be planted in 4 rows on 25-foot centers. Each row will be 3,000 feet long. The first row will start 50 feet from the bank of Butte Creek. The species mix and density is shown in Table 3.

**Table 3. Planting plan for 9.0 acres of low terrace mixed riparian.**

Species	Frequency	Plants/Acre	Total Plants	Propagation
Valley Oak	10%	15	135	Acorns
Cottonwood	20%	30	270	Cutting
Willow	20%	30	270	Cutting
Ash	10%	15	135	Container
Box elder	20%	30	270	Container
Sycamore	10%	15	135	Container



Buttonbush	10%	15	135	Container
<b>Total</b>	<b>100%</b>	<b>150</b>	<b>1,350</b>	

The species mix and planting density for the seasonal wetland is shown in Table 4.

**Table 4. Planting plan for 6-acre seasonal wetland. Note the wet grasses will be planted on the channel bottom and the drier grasses will be planted on the channel walls.**

Species	Frequency	Plants/Acre	Total Plants	Propagation
<i>Wet-Grasses</i>				
Bolander's Rush	5%	2,178	500 Plugs	Plugs/Seed
Iris Leafed Juncus	5%	2,178	500 Plugs	Plugs/Seed
<i>Drier-Grasses</i>				
Santa Barbara Sedge	25%	NA	500 Plugs	Plugs/Seed
Deer Grass	5%	NA	8 lbs/Acre	Seed
Creeping Wild Rye	25%	NA	20 lbs/Acre	Seed

The remaining 40 acres of the site will be planted with a mix of native grasses and cover crop species designed to decrease weeds and provide cover and food for wildlife. The species mix and planting density for the grassland is shown in Table 5.

**Table 5. Planting plan for 40-acre grassland.**

Common Name	Latin Name	Seed Rate
Slender Wheatgrass	<i>Agropyron trachycaulum</i>	8 lbs/acre
Purple Needlegrass	<i>Nacella pulchra</i>	5 lbs/acre
Blue Wild Rye	<i>Elymus glaucus</i>	8 lbs/acre
Meadow Barley	<i>Hordeum brachyantherum</i>	8 lbs/acre
Buckwheat	<i>Fagopyrum esculentum</i>	10 lbs/acre
Bicolored Lupine	<i>Lupinus bicolor</i>	3 lbs/acre

Irrigation- is the single most important factor in the success of riparian restoration plans in California. Adequate soil moisture allows plants to grow vigorously and compete effectively with weeds. Irrigation of newly-planted seeds will be necessary to promote seed germination and establishment. Irrigation will be provided by solid set sprinklers. Irrigation may not be necessary in the second season. The decision to irrigate will be made prior to the dormant season and will be based on results of monitoring plant establishment and cover.

Source of propagules- all plant material will be collected from the where possible and the vicinity of the project site for species not found on the site.

Purchase/Container growing of plant material- Approximately 25% of the container grown plant material will be produced by local high school students for a class project. The remaining propagation will be done by both CSU, Chico and the US Forest Service.

## 5.0 Methods of Installation

Project staff and volunteers from local schools and the community will plant the trees and grasses. All volunteers will be trained in proper planting techniques.

### 5.1 Grass-Planting Techniques

The species in the grass mixture were chosen to provide slope and bank stabilization of sites with soil moisture conditions that range from wet to droughty. *Bromus carenadis* (a short lived native grass) seeds will be broadcast for erosion control, weed suppression, and to act as a "nurse" crop for the perennial bunch grasses to be used on the site. These grasses will be planted as 6" plugs on the channel walls between September and January.

If necessary, two weeks prior to seeding of the brome, a broad spectrum herbicide will applied. Brome will be seeded over tops and side slopes of channel at a rate of 20 lbs/acre. Perennial grass species will either be hand planted into the brome on 2'6" centers or seed will be broadcast. Grasses will be irrigated for the first two years as necessary.

### 5.2 Woody Perennial Planting Techniques

All woody plants will be planted between September and January. Sites for woody perennials may require augering and backfilling to provide suitable planting conditions. Trees and shrubs will be irrigated for the first two years as necessary.

## 6.0 Planting Timeline

The planting timeline is shown on Figure 8.

## 7.0 Long-Term Maintenance of Revegetation Planting

Because the site is located on the flood plain of Butte Creek, the revegetation planting will require perpetual maintenance to ensure that vegetation does not become too dense and that brush and debris does not build up on the site and increase the potential of downstream flooding.

#### 7.1 Irrigation

Irrigation will be used for two years; after that time, the pumps will be removed and irrigation will cease.

#### 7.2 Weed control in the riparian band-

The standards for weed control are listed as follows:

First year: Weed height within the rows is kept to less than 24". The strips should be maintained more diligently than the rows. Clean cultivation is strived for.

Johnson grass stem density within the strips should be less than 50/m<sup>2</sup>.

Second Year: Weed height within the rows is kept to less than 24" and along the strips it is kept to less than two thirds the average height of the shortest stature woody species. Clean cultivation becomes more difficult because of the spreading nature of riparian species.

#### 7.3 Control of invasive exotic species- will be an ongoing management objective.

Invasive species will be eradicated on a yearly basis with hand control (spot spray and hoeing) and mowing.

- Himalayan blackberry (*Rubus discolor*) will be allowed to remain for erosion control on the Banks of Butte Creek. It will be slowly replaced with natives such as wild rose.
- Tree-of-heaven (*Ailanthus altissima*) will be continuously eradicated by hand.
- Johnson grass (*Sorghum halepense*) will be allowed to remain for erosion control on the Banks of Butte Creek. It will be slowly replaced with natives such as wild rose. It will be spot treated with herbicide on the internal portions of the site.
- Yellow-star thistle (*Centaurea solstitialis*)
- Pepperweed (*Lepidium latifolium*)

#### 7.4 Thinning and Woody Debris Management-

To maintain the coefficient of roughness at the site, all volunteer woody vegetation will be eradicated from seasonal wetland and grassland by mowing with a brush cutter once a year. This mowing will act to thin any volunteer riparian vegetation before it becomes fully established. Any brush will be piled and chipped. Any woody debris of a diameter greater than 2" will be cut into 3' sections.

## 8.0 Erosion control

The site is located in a depositional position on the landscape (sediments are being deposited rather than transported by erosion). The dense roots of riparian vegetation and native grasses will further stabilize the site. The banks of Butte Creek will be closely monitored. If slumping does occur bank stabilization measures such as willow wattling will be taken.

Straw bales and silt fences will be used as needed during the excavation of the channel to ensure that sediments do not impact Butte Creek.

## 9.0 Monitoring

A five year maintenance and monitoring program will be established. Monitoring will include documenting the success of newly-planted material, ensuring that irrigation is sufficient, and noting animal damage and weed invasion. Data gathered will be analyzed and corrective measures will be determined. An annual report will be prepared which describes revegetation measures implemented, maintenance activities, results of revegetation performance studies, and projected revegetation activities for the coming year. Monitoring will be performed by qualified personnel.

### 9.1 Monitoring During Installation

A qualified restoration specialist will inspect the site during installation to verify revegetation performance.

### 9.2 Erosion Control Monitoring

A qualified restoration specialist or maintenance contractor will monitor erosion control during the rainy season. The site will be inspected for erosion problems during the week following any occurrence of two or more inches of rain during a 24 hour period. Any erosion problems will be corrected during the following week.

### 9.3 Weed Monitoring

The stands of tamarisk on the island to be removed will be monitored to assure they are successfully eradicated. All other weeds will be controlled on a case by case basis as described in the sections on weeding.

### 9.4 Revegetation Monitoring

Monitoring of all revegetation efforts will take place on a yearly basis during the active growing season (March, April, May, June). A random sampling method will be utilized for each habitat type and planting area. Sampling will provide

information about species presence or absence and percent total cover. Number of samples required to provide 80% confidence limit for the data will be determined in the field.

## 10. Performance Standards

The preserve is a highly disturbed site; it is not feasible to set performance standards to match existing vegetation's performance. Performance will be measured in terms of percent cover and native species diversity for each of the revegetated areas. Number of samples will be determined to provide 80% confidence limits for the data.

Planting, maintenance, and monitoring work will be directed toward achieving the following minimum by the end of the first five years (thriving is defined as 90% of the individuals in active growth during the growing season, March-June):

- For the riparian band there will be at least 70% total cover, with at least seven out of the nine woody species planted present and thriving.
- For the seasonal wetland, there will be at least 50% total cover, with at least 75% of the species planted present and thriving.

### Corrective Action:

Minimum Performance standards have been set for 5 years; in all cases, corrective action will be taken whenever trends suggest that these standards will not be met. Corrective actions may include erosion control measures, overseeding, replacing plants, or more aggressive weed control.